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Conference Abstract

Forensic Applications in Biodiversity Research: The Clock Is Ticking for Registering Biodiversity (Meta)data

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Abstract

With climate change and accelerating biodiversity decline, lawmakers have been implementing legislation to curtail the negative impact of human actors on further decline. A few noteworthy legal acts are the European Union Deforestation Regulation (EUDR, Reg. EU 2023/1115) in 2023 and the updated European Environmental Crime Directive (ECD, Dir. EU 2024/1203) in 2024. Enforcing these legal instruments requires forensic scientific services able to provide traceable, auditable evidence for provenance, habitat change, and chain-of-custody.

Introduction

Biodiversity loss represents a systemic risk to human well-being and planetary function; this has been synthesised in the IPBES Global Assessment (IPBES 2019) and earlier conservation science (Soulé 1985. Economic thinking incorporated ecological risk through natural-capital accounting and valuation of ecosystem services (Costanza et al. 1997), which helped motivate legal instruments that translate ecological risk into enforceable rules. The EUDR obliges companies placing forest-risk commodities (FRCs: timber, coffee, cocoa, soy, palm oil, rubber) on the EU market to exercise due diligence to

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exclude links to deforestation and degradation, while Member States must verify compliance using scientific evidence.

Results and operational work

Within the Horizon Europe GUARDEN project (https://cordis.europa.eu/project/id/101060693) we developed a decision-support application (DSA) to inform policy choices with biodiversity data. Use of DSAs in regulatory contexts raises forensic questions: who bears responsibility for decisions, how is uncertainty documented, and can DSAs be adapted to produce court-usable artefacts as evidence? Converting digital policy tools into forensic-grade outputs requires provenance capture, immutable audit trails, model-versioning, and explicit uncertainty propagation.

Dr. P. Bonnet has contributed significantly to the monitoring of plants through the Pl@ntNet initiative (Lefort et al. 2024). Together with Dr. A. Joly they cary out research to access the uncertainty in biodiversity modelling and emphasise quantifying identification error, observer bias; these metrics define whether species-level inferences reach forensic viability. Model-sensitivity analyses can be inverted to identify minimal sampling density and taxonomic resolution needed to meet legal evidentiary thresholds in priority areas.

Dr. Ch. Van Neste established an atomic-elemental laboratory at Meise Botanic Garden to characterise elemental fingerprints of FRCs and build reference baselines in collaboration with Dr. V. Declerck from World Forest ID (Deklerck et al. 2024). The lab was designed with forensic principles: documented Standard Operating Procedures (SOPs), instrument calibration records, and an open-source traceability platform deployed via Infrastructure-as-Code (IaC) to enable reproducible, auditable instances for other labs or corporate due-diligence systems (https://github.com/AgentschapPlantentuinMeise/MeiseCSI).

Discussion

A recurring concern at Living Data 2025 was incomplete metadata and sampling bias in historical and contemporary biodiversity databases; these omissions produce a “data shadow” of unseen assumptions and missing observations that undermines forensic credibility (Leonelli et al. 2017). Forensic utility demands (1) standardised metadata schemas capturing geolocation with uncertainty, timestamp, collector identity, sampling protocol identifiers, chain-of-custody tags, and Certified Reference Material (CRM) usage; (2) reference baselines (elemental, isotopic, genetic) with documented spatial coverage and measurement uncertainty; (3) accredited lab networks and inter-lab proficiency testing; (4) auditable software (immutable logs, versioned models, IaC); and (5) training for expert witnesses to communicate quantified uncertainty against legal standards of proof.

Conclusion

This session acted as a call to action. Decision-support tools are necessary but insufficient without forensic design: SOPs, metadata-first capture, uncertainty

quantification, accredited analyses, and capacity building for experts and communities. Registering high-quality and comprehensive biodiversity metadata is a minimal requirement to enable enforcement of legal instruments such as the EUDR and the strengthened ECD; the clock is ticking.

Keywords

forensics, forest-risk commodities, Environmental Crime Directive, European Union Deforestation Regulation

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Conflicts of interest

The authors have declared that no competing interests exist.

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